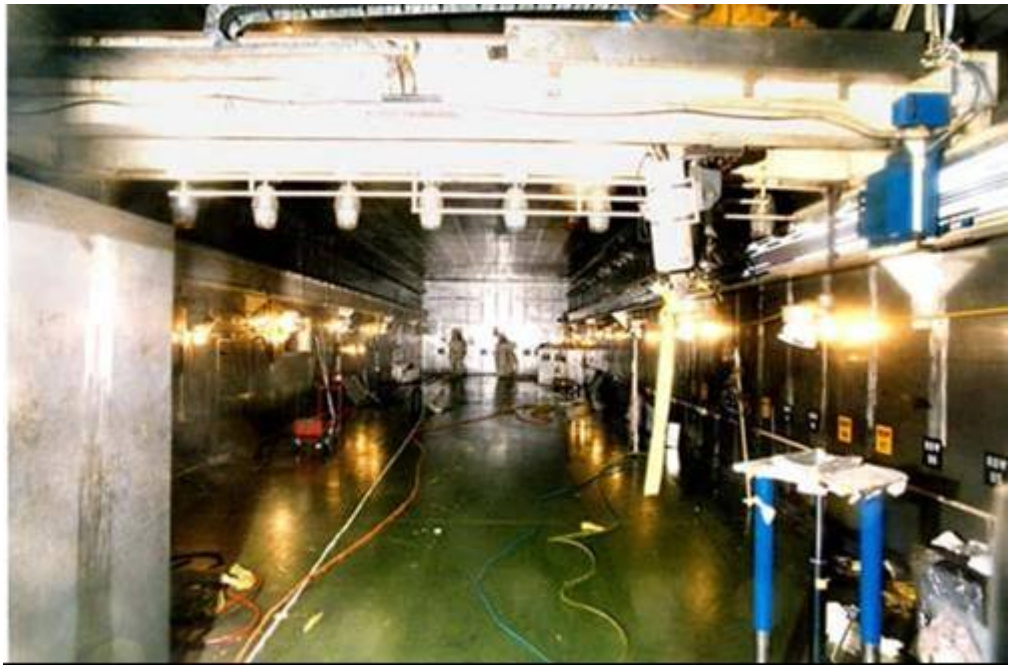
Rocky Flats Closure Legacy
Special Nuclear Material Removal Project



The Building 707 X-Y retriever before and after. Special Nuclear Materials were safely shipped to other sites, removing the hazard from metropolitan Denver.

SPECIAL NUCLEAR MATERIAL REMOVAL PROJECT

INTRODUCTION

Special Nuclear Material Inventory

Kaiser-Hill assumed management responsibility for the Rocky Flats Environmental Technology Site (Site, Rocky Flats, or RFETS) in July, 1995. At that time, the Site had the largest plutonium (Pu) inventory of any Department of Energy facility. The Site also had a significant quantity of highly enriched uranium (HEU). These "special nuclear materials" (SNM) required characterization, stabilization, packaging for long-term storage, consolidation, repackaging/overpacking into approved shipping containers, and removal from the Site before K-H could focus on the deactivation and "decontamination and decommissioning" (D&D) of the Site's nuclear facilities.

ACCELERATED CLOSURE
CONCEPT
CONGRESSIONAL SUPPORT
REGULATORY FRAMEWORK
CONTRACT APPROACH
PROJECTIZATION

SAFETY INTEGRATION
SPECIAL NUCLEAR MATERIAL
DECOMMISSIONING
WASTE DISPOSITION
ENVIRONMENTAL RESTORATION
SECURITY RECONFIGURATION
TECHNOLOGY DEPLOYMENT
END STATE AND STEWARDSHIP
FEDERAL WORKFORCE
STAKEHOLDER INVOLVEMENT

The Department of Energy declassified the Site's SNM inventory in 1994. When Kaiser Hill started at the Site, the SNM inventory included 12.9 metric tons of Pu and 6.7 metric tons of enriched uranium. The Pu inventory included 6.6 metric tons of relatively pure Pu metals; 3.2 metric tons of Pu in approximately 6 bulk tons of Pu oxides; and 3.1 metric tons of Pu in approximately 106 bulk tons of Pu residues. The enriched uranium was in various forms. Additionally, the Site had numerous "Special Items" that required special handling due to weapons classification and nuclear safety concerns.

History of SNM at Rocky Flats

As a result of the evolving Rocky Flats mission from 1989 to 1993, a large inventory of Pu was left in an indeterminate storage configuration.

The mission of Rocky Flats was the production of nuclear weapons components (pits). Production began in 1952 and continued until 1989. The Site also disassembled retired pits to recover Pu and HEU for reuse. Supporting operations were conducted to recover Pu and uranium from retired weapons components, processing Pu scraps, and Pu residues to purify the Pu for use in weapons. In December of 1989, the Department of Energy curtailed Pu operations at Rocky Flats due to safety and environmental concerns. The DOE anticipated that plant operations would resume shortly after a new contractor had taken over the management and operation of the Site. Therefore, the Pu facilities were maintained in a production configuration with SNM in the glovebox lines ready to resume operations. Unfortunately, the "resumption" of nuclear operations was delayed due to persistent safety concerns. Before weapons production could restart, the president made the decision in 1992 to suspend nuclear weapons production, and later eliminated the Rocky Flats weapons production mission entirely. Subsequently, the Site mission evolved from a standby status through a period of improving safety and deactivating unused equipment, to the final DOE decision to accelerate the D&D of the

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Site. As a result of this evolving mission a large inventory of Pu was left in an indeterminate storage configuration.

The safety basis for nuclear operations assumed a certain set of conditions. The facility was in an indeterminate status after the Rocky Flats shutdown. It was imperative to understand actual storage configuration for nuclear materials during any deviation from routine

Changes in the Site Mission

The Site mission had changed from nuclear weapons component production in the 1980s to cleanup and closure by the mid-1990's. Unfortunately, when nuclear production operations were curtailed in 1989 it was anticipated that the Site would "resume" operations within a very short period of time. The nuclear facilities shut down with SNM in the glovebox lines staged for the impending resumption of operations. It was not anticipated that this suspension of production operations would be permanent, therefore the majority of the SNM was not placed into a long-term storage configuration. In fact, at that time, the DOE had no standard for long-term storage of Pu or HEU. As it became clear that nuclear production operations would not resume at the Site, it was also recognized that the SNM should not remain in the glovebox lines indefinitely due to safety and Safeguards & Security considerations. In the early 1990s it was unclear what the final disposition of this material would be, therefore, the majority of the material was packaged in accordance with existing Site Health & Safety requirements and placed into secure storage in vaults.

In 1995 the Site's 12.9 metric tons of Pu were stored in about 27,000 packages. The majority of this Pu was packaged for short-term storage to support production operations. The DOE complex-wide concern regarding the storage conditions for Pu materials resulted in DOE developing a standard for all sites that would dictate how these materials should be packaged and stored when not in the weapons production cycle. The result was the DOE standard (DOE-STD-3013-1994) that established the criteria for stabilization, packaging, and long-term storage of Pu.

Delays in resumption ultimately resulted in safety and safeguards deficiencies, the very areas the resumption effort was trying to improve.

The "resumption" of weapons production changed to "resumption" of those nuclear operations necessary to support Site cleanup and closure. The resumption of Pu thermal stabilization operations in Building 707 was required to safely store Pu oxides at the Site. The Pu oxides could not be stabilized until Building 707 resumed nuclear operations. During this time the Site curtailed handling Pu metals and oxides that were not compliant with the Site's health and safety requirements to minimize the risk of a fire or contamination event due to unstabilized oxides on the metals or in containers awaiting stabilization. The restrictions on handling these items prevented performing proper inventories, including non-destructive assay measurements, of the affected SNM. Ironically, the delays in resumption ultimately resulted in safety and safeguards deficiencies, the very areas the "resumption" effort was trying to improve.

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The Site's SNM shipping infrastructure was dramatically reduced during the 1990's as a result of the curtailment of nuclear production operations and subsequent shipping program inactivity. As the SNM Shipping Project ramped up in the late 1990's, the infrastructure did not grow accordingly and many of the remaining staff lacked historical experience. In 1998 the SNM Shipping Project was shut down by the DOE regulator due to significant procedural compliance deficiencies. The project did not resume packaging and shipping SNM for several months while significant improvements were implemented with appropriate staffing increases.

Another complicating factor in the mid-1990's was the DOE decision to place one ton of Pu at Rocky Flats under International Atomic Energy Agency (IAEA) safeguards. Although this decision was supportive of the federal policy with regard to excess fissile materials, the additional IAEA safeguards associated with placing this material under IAEA control significantly impacted the Site's ability to stabilize and repackage this material for long-term storage and eventual shipment offsite.

DISCUSSION

This section addresses specific topics that were key to understanding the Rocky Flats approach for managing and ultimately disposing of its SNM.

Rocky Flats SNM Program

The Rocky Flats Site was established with the purpose of manufacturing nuclear weapons and maintaining all of the associated processing activities necessary to providing pure Pu metal. This purpose required maintaining significant inventories of SNM, primarily plutonium. Removal of these inventories was one of the major challenges to closure of the Site and one that had to be accomplished before facility decommissioning and Site restoration could be completed. Time, costs, and schedules could only be approximated based on the technologies available. Improvement of these technologies and development of new ones had to be carried out in parallel with actual operations. Activities needed to disposition the actual nuclear materials were conceptually understood, however, performing these operations to meet the new DOE standard to prepare the material for long-term storage was something that had not been attempted.

Removal of these inventories was one of the major challenges to closure of the site and one that had to be accomplished before facility decommissioning and site restoration could be completed.

The organization of the SNM program was centered on three activities. First was the actual stabilization of the material; second was the packaging into a welded package; and third was the acquisition of a newly designed shipping container and actual shipping. During the completion of the program some lower purity oxides were packaged and shipped to the

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WIPP. In the original classification of Pu oxides, these lower purity oxides were not considered residues. Disposition of large quantities of residues and contaminated wastes, associated with the Pu processing activities, was also necessary for Site closure.

SNM Consolidation

In the mid-90s the Site recognized the need to begin deactivating the nuclear buildings if there was no further need for operations. In order to deactivate these facilities it was recognized that it would be beneficial to consolidate all SNM into as few buildings as possible to support deactivation and eventual D&D of these buildings. Additionally, as a result of safety concerns related to Building 991's underground storage vaults, the DOE decided to expedite consolidating all SNM from Building 991 into Building 371. Building 371 was utilized because it was the newest and most robust of the Pu processing facilities. Building 371 required significant upgrades to satisfy security requirements and to address seismic safety concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB). The safety upgrades were performed in a phased manner, the most costly and long term upgrades were scheduled to be performed ONLY if onsite storage of SNM would exceed about five years. This decision pressured the DOE to identify alternate SNM storage strategies, including building an interim storage vault onsite or accelerating offsite shipment of all SNM. These alternatives were presented and discussed publicly with a very strong preference expressed by the stakeholders for accelerated offsite shipment. Addressing the risks from the SNM became one of the most driving reasons for creation of the accelerated closure plans in 1995 and beyond.

Regulatory liabilities should be analyzed against nuclear safety liabilities when developing NEPA processes. These processes routinely experienced bureaucratic and political hurdles, resulting in unnecessary delays in SNM reconfiguration.

NEPA

The National Environmental Policy Act (NEPA) requires the government to evaluate the environmental impacts of federal decisions prior to taking any federal action. For the majority of the Site's SNM, the DOE had to complete several Environmental Impact Statements (EIS) or Environmental Assessments (EA) prior to initiating shipping SNM offsite. The most significant NEPA documents affecting SNM removal are listed below. Each of the EIS or EA documents was individually challenging, but the coordination of all the NEPA documents became a significant regulatory and public participation effort that the RFFO was initially not well prepared to address. RFFO learned that the SNM issue involved not only complex technical and safety challenges, but also substantial regulatory and compliance issues, sometimes appearing more daunting than the technical issues. The DOE public affairs and regulatory staff

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needed to be substantially increased to meet the SNM NEPA and regulatory coordination requirements.

- Consolidation and Interim Storage of SNM at RFETS Environmental Assessment (authorizing the Site to consolidate SNM into Building 371)[80]
- Disposition of HEU Final EIS (identified Y-12 as the primary HEU receiver site)[81]
- Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS (identified Pantex as the receiver site for pits and the Savannah River Site (SRS) as a future receiver site for Pu metals and oxides)[82]
- Surplus Pu Disposition Final EIS (confirmed that SRS would receive Pu metal and oxides)[83]
- Final EIS on Management of Certain Pu Residues and Scrub Alloy Stored at the RFETS (determined that most residues would be disposed of at the Waste Isolation Pilot Plant (WIPP) but that Sand, Slag, & Crucible (SS&C) and Fluoride residues, and Scrub Alloy Pu would be sent to the SRS for recovery operations)[84]

Pu Storage Safety Concerns

In March 1994, the Secretary of Energy commissioned a comprehensive assessment to identify the vulnerabilities that might arise from the storage of Pu in an inactive configuration. This assessment was initiated because of recent ruptures of stored Pu packages and the need to safely store the large amounts of Pu-bearing materials held in aging facilities around the country. The ultimate goal of the assessment was to facilitate safe and stable interim storage of Pu materials.

The Pu and HEU solutions were identified as the most significant hazards at Rocky Flats.

Independent of the DOE assessment, the DNFSB issued Recommendation 94-1 in May 1994.[87] DNFSB Recommendation 94-1 contained several recommendations to improve the interim storage conditions resulting from the halt in production of nuclear weapons. For Rocky Flats, one of the key recommendations was for all Pu metals and oxides to be stabilized and repackaged in compliance with the DOE-STD-3013-94 standard[86] and to stabilize all Pu liquids and residues.

Both of the above assessments revealed a number of vulnerabilities. Rocky Flats Buildings 771 and 776 were identified as the most vulnerable facilities in the DOE Complex. The reason for this classification was the large quantities of plutonium-containing solutions and the large number of Pu packages that were improperly packaged.

The Pu and HEU solutions were identified as the most significant hazards at Rocky Flats. These acid solutions had been sitting idle in tanks for years and presented a leaking, corrosive, explosive, radioactive spill hazard. Also, the criticality safety risk is higher with solutions, exacerbating the risks involved with venting, draining, and processing these solutions.

DOE Approach to DNFSB-94-1 Issue Resolution

In response to DNFSB Recommendation 94-1, DOE issued an implementation plan to systematically address the recommendations in an integrated manner for all sites. The foundation for addressing the packaging and storage of Pu metals and oxides was the issuance of the DOE-3013 Standard. Under this standard all Pu metal and oxide containing greater than 30 weight percent Pu would be stabilized and packaged in 3013-type containers. In line with supporting the goal of accelerating closure of Rocky Flats, Pu materials compliant with the 3013 standard would ultimately be shipped to the SRS for long-term storage.

The Plutonium Stabilization and Packaging System (PuSPS) was developed to meet the DOE 3013 requirements for Pu metals and oxides. PuSPS was a complicated prototype that was never intended for production operations. The DOE planned to use the PuSPS to demonstrate the benefits of an automated system and then install production models at all sites including RFETS. This plan was abandoned when it was realized early on that a basic manual stabilization and welding process would be cheaper and more reliable. The prototype at RFETS was installed and nearly operational when the contractor recommended utilizing a manual system. The DOE directed the Site to use the PuSPS to failure; this decision was primarily based on the sunk cost invested into the design, testing, and installation of the PuSPS.

The PuSPS was unreliable and difficult to operate. Work-arounds were developed to provide for maintenance and engineering response on an immediate basis, 24 hours a day. The PuSPS was made to complete its mission through "brute force" effort by management and workers. Ultimately the Site was able to satisfactorily certify 1,895 3013s and ship them for storage to the SRS. Although the Site completed the SNM Removal Project one year late and significantly over its budget, in the final analysis this did not delay the accelerated closure due to creative workarounds.

At least one DOE site was directed to reweld many of their 3013s due to certification issues associated with their manual system.

It is unclear whether a manual 3013 packaging system could have been purchased, installed, and certified in time to support the Site's SNM Removal Project. The certification process was very cumbersome and at

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least one DOE site was directed to re-weld many of their 3013s due to certification issues associated with their manual system.

Pu and HEU Solutions

The Pu solutions were identified as high risks at the Site. In late 1994 the Site started the process of venting, draining, and processing the solutions from all Pu buildings. Some of the tanks had to be vented due to concerns about potential hydrogen buildup. The tanks were drained into bottles to reduce the criticality safety concerns associated with large volumes of Pu solutions leaking from corroded tanks and/or pipes, or spilling from a collapsed tank after a seismic event. The low concentration Pu solutions were then processed in Building 771 while the high Pu solutions were processed in Building 371. The Caustic Waste Treatment System utilized a precipitation line in Building 371 that removed the majority of the Pu from the solution. The resulting precipitate was disposed of as radioactive waste. The low-Pu solution was then processed with other low-Pu solutions in Building 771. In October 1994 the Site suspended Pu solution draining after the Building 771 crew grossly violated the draining procedure. This was a serious criticality safety violation because the workers mixed high concentration Pu solutions that were not analyzed from a criticality safety standpoint. In December several other Pu tank draining procedure violations were identified. The Site implemented vigorous corrective actions including termination of some employees for knowingly disregarding procedural requirements. The Site completed draining the Pu solutions in February 1998. A total of 31 tanks containing nearly 11,000 liters of Pu and uranium solutions were drained. The Site completed precipitating the high-level Pu solutions in July 1998.

The Site implemented vigorous corrective actions including termination of some employees for knowingly disregarding procedural requirements.

One of the highest risk vulnerabilities identified at the Site was the 2,700 liters of highly enriched uranyl nitrate (HEUN) solutions in Building 886. The scenario of concern involved a seismic event upsetting a storage tank and allowing a criticality to occur in the facility. The Site began draining the Building 886 tanks in July of 1996. The HEUN solutions were drained by October and shipped to Nuclear Fuels Services in Erwin, TN for conversion to nuclear reactor fuel. The Site obtained Nuclear Regulatory Commission (NRC) certification to ship these solutions in the FL-10. The NRC certification was quicker than the DOE certification process which was cumbersome and inefficient.

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The draining and processing of the Pu and HEU solutions significantly reduced some of the greatest hazards on Site. However, the Site still had significant quantities of Pu metals and oxides that required stabilization, repackaging, and removal from the Site.

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SNM Shipping

The Site began shipping HEU parts to the Y-12 facility in Oak Ridge, Tennessee in 1996. The DOE published the "Record of Decision (ROD) for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement" in January 1997. This ROD authorized the Site to begin shipping pits to Pantex immediately but stipulated that Pu in other forms could not be shipped until it was stabilized and packaged in accordance with the DOE 3013 standard. Additionally, the receiver site was identified as the SRS, however, it was stipulated that no Pu would be shipped to the SRS until several conditions were met including construction of a new Actinide Packaging and Storage Facility (APSF) and a decision to locate the Pu immobilization facility at SRS.

Receiver sites for SNM must be identified, funded, and directed to provide priority to the shipping site. The infrastructure associated with SNM storage is substantial, and any disruption to SNM removal activities impacted the entire closure project.

The Storage and Disposition ROD confirmed that some pits could be sent to the National Labs (LANL and LLNL) to support R&D and National Security programs. At the time the labs were experiencing delays due to safety issues and were involved in their own "resumption" programs, preventing them from receiving SNM. Initially, the labs were unable to receive the Site's pits and other SNM parts because national DOE Weapons Program activities were a higher priority than merely supporting the de-inventory of Rocky Flats. Ironically, LANL requested that some of Rocky Flats' Pu be reserved for the Weapons Program, however, the lab did not have the ability to receive this material. The labs were eventually directed by NNSA to receive the Rocky Flats Pu in support of the Rocky Flats cleanup schedule.

The Site had a small quantity of Low-Enriched Uranium (LEU) that the Tennessee Valley Authority (TVA) was interested in obtaining. The TVA was unable to receive this LEU for several years. The Site identified an alternate disposition path for this material (disposal as Low-Level Waste (LLW) at the Nevada Test Site (NTS)) and informed the TVA that the deadline for transfer to TVA would expire in six months, after which the LEU would be disposed of as LLW. The TVA continued to demonstrate interest in the material until the Site actually shipped the LEU to NTS. The TVA could not make arrangements to receive the material in time to support the Site's closure schedule and the LEU was disposed of as waste. While this action represented a lost resource and opportunity for the TVA, it eliminated an entire category of waste from the Site and was a major step forward for the SNM program. This decision was very difficult and controversial at the time, but demonstrated the degree to which the Site and DOE HQ had aligned to the central focus of accelerated closure.

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The majority of the Site's 106 tons of Pu residues were scheduled for stabilization and repackaging as transuranic (TRU) waste for disposal at the WIPP. These Pu residues contained 3.1 tons of Pu in 103 bulk tons of material or, on average, approximately 3% Pu. Historically, the DOE had planned to recover the Pu and dispose of the by-products as radioactive waste. In the mid-1990s the DOE determined that over 200 tons of fissile materials were excess to national security needs. Many of these residues across the country, but especially at Rocky Flats, had been speculatively kept for future processing to recover the Pu for weapons production. The Site recommended that the Pu residues should be disposed of in light of the fact that there was no programmatic need to recover the Pu. In August of 1998 the DOE approved an exemption to the Safeguards Termination Limits (STL)[85] to allow residues with higher Pu concentrations to be blended down with other materials, thereby making them unattractive for Pu recovery and available for disposal as waste at the WIPP. This dramatically reduced the amount of processing required to dispose of the majority of residues. A small population of the easily recoverable residues with higher concentrations of Pu (SS&C and fluorides) were originally slated for Pu recovery at the SRS canyons. Although the Site did begin shipping SS&C to the SRS, a number of technical issues affecting the shipping container delayed the shipping campaign. The fluorides were Resource Conservation Recovery Act (RCRA) regulated wastes. There were significant challenges associated with shipping RCRA-regulated waste in the DOE secure transportation system, due to the fact that the drivers were not certified to transport RCRA-regulated hazardous waste. In light of these difficulties and as a result of the STL approach, the DOE revised the ROD to send all of the SS&C and fluoride residues to the WIPP. The SS&C and fluorides were downblended to satisfy the STLs and disposed of at WIPP.

Historically the DOE had planned to recover the Pu from the residues. DOE later determined that over 200 tons of fissile materials were excess to national security needs and the Site recommended that the Pu residues should be disposed of as waste.

Shipping Containers

The Site utilized a significant variety of DOE certified Type B shipping containers during the SNM removal campaign. It was recognized early on that in order to support the aggressive shipping campaign the Site would have to use existing containers that were already approved or could be readily approved for shipping Type B quantities of SNM. No new Type B containers were considered due to the fact that the container certification process could not be accelerated to support the Site's schedule. The program to manage the container certifications, as well as the shipment of containers, was a critical aspect of the overall SNM removal.

It was recognized early on that in order to support the aggressive shipping campaign the Site would have to use existing containers that were already approved or could be readily approved.

The DOT 6M container was the first considered as the Site had considerable experience with it from weapons production use. Although the DOT 6M had been used for years to ship Pu metal throughout the

weapons complex, the DOE was in the process of retiring the DOT 6M from Pu shipping. The Site did use the DOT 6M to ship some Pu metal to the labs and scrub alloy to the SRS. After completing the scrub alloy campaign the Site agreed to retire the DOT 6M and utilize a performance based package. The Site also used the 9965 and the 9968 Type B shipping containers in the early days of the shipping campaign however there were limited quantities of these containers and they could not hold a 3013 package. Ultimately the certification for these two packages was allowed to lapse as newer packages were approved (i.e., 9975, SAFKEG).

Many times documentation was difficult if not impossible to obtain yet the Site still had to provide the certifying official with sufficient technical justification to demonstrate that the pit could be safely shipped.

There was no certified container available in sufficient quantities to support the total Site SNM removal project. The 9975 and the SAFKEG were both nearing certification and the Site was willing to use either container if it could be certified to meet the Site's needs in time. The 9975 was the first to be certified for Rocky Flats Pu. The Site began procuring 9975's for shipping 3013 containers to the SRS and storing them at K-Area. The SAFKEG was the preferred shipping container because it was lighter and more containers could be shipped in a Safe Secure Transport (SST). However, the SAFKEG was not certified in time to be used at RFETS. It is unclear whether the SAFKEG could have been used for all of RFETS Pu. The SAFKEG is lighter because it has less shielding. Several of RFETS 3013's produced very high radiation readings and nearly exceeded the shipping limits (some had to be repackaged). These 3013's could not have been shipped in the SAFKEG, therefore the 9975, although heavier and, arguably, more expensive was the only Type B shipping container that was certifiable for the Site's Pu.

The Site shipped pits in the Model FL container. The majority of the pits could be packaged and shipped in full compliance with the FL Safety Analysis Report for Packagings (SARP). There was a small population of pits that did not comply with the SARP for various reasons and required special review and approval by the SARP certifying official. This process was difficult because many times documentation was difficult if not impossible to obtain, yet the Site still had to provide the certifying official with sufficient technical justification to demonstrate that the pit could be safely shipped. Although the Site could have streamlined the process by providing better information upfront, ultimately the certifying official was satisfied that all regulatory, safety, and technical requirements were satisfied and the Site was approved to ship all pits in the Model FL shipping container.

The Site requested a national security exemption (NSE)... Although the NSE was granted the DOE decided not to utilize the DT-22 for shipping these items to LLNL due to a lawsuit.

The majority of the Site's HEU metal was shipped in the Model DT-22 shipping container, utilizing a certification process similar to that used for the Model FL. A small number of large HEU items were shipped using the larger DT-23, requiring a similar certification process. The Site had a

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number of Pu composite items that would fit in the DT-22, however, the DT-22 was not certified for these materials. (Pu composites are Pu metal items bonded to some other substrate such as HEU, beryllium, vanadium, etc.) The Site requested a national security exemption (NSE) to authorize using the DT-22 for a one time shipment of these items to the Lawrence Livermore National Laboratory (LLNL). Although the NSE was granted, the DOE decided not to utilize the DT-22 for shipping these items to LLNL due to a lawsuit challenging the DOE's authority to exempt itself from DOT requirements. This decision required the Site to install a metal size-reduction process in Building 371 (Building 707 had already shutdown its size-reduction process) and size-reduce the parts for shipment in the 9975. Additionally, the 9975 had to be certified for the composite parts and the SRS had to prepare to process the parts instead of the LLNL.

Disposition of Highly-Enriched Uranium

In 1998 the Site purchased and installed an unproven HEU decontamination system designed to remove Pu from HEU. The HEU decontamination project assumed that this system could decontaminate every Pu contaminated HEU item to allow the HEU to be shipped to Y-12. As a result of multiple failures a detailed evaluation was performed and it was determined that the system was not designed to decontaminate many of the HEU items that the Site planned to decontaminate. The study recommended several alternative approaches such as acid leaching, machining, and oxidation, however, the DOE did not want to install or restart these systems onsite because of the cost and time involved. Ultimately the DOE decided to ship the Pu contaminated HEU items as-is to the SRS for further processing.

SNM Storage at the SRS

When EM could demonstrate that the receiver site was able to receive and that RFETS was ready to ship then NNSA provided adequate resources to support Site closure.

While the Site was stabilizing and packaging Pu into 3013's in preparation for long-term storage at the SRS, the DOE cancelled the APSF and the immobilization mission at SRS. Both of these had been established as prerequisites for shipping Rocky Flats' SNM to SRS per the earlier EIS decision. In order to support RFETS de-inventory an alternative was needed, and the DOE decided to take an existing SRS facility and retrofit it for storage of Rocky Flats' Pu. The K-Area Material Storage (KAMS) facility was a former reactor building that was modified for storing 3013 storage containers in 9975 shipping containers. The 9975 container was required due to the fact that the KAMS did not provide adequate confinement and the 9975 was therefore credited as a confinement barrier. The fact that the 9975 was used for storage at KAMS meant that the 9975 could not be reused for shipping and that many more 9975 were procured

than originally planned (the Site originally planned to procure approximately 300 9975 to support its needs). The Site shipped a total of 1,895 3013s in 9975 shipping containers for storage at SRS. Additional 9975s were procured to support the residues, SS&C, and composites shipping program. Any excess 9975s were provided to other DOE sites to support their SNM shipping programs.

The governor of South Carolina sued the DOE to prevent shipping RFETS SNM to SRS until the DOE identified a disposition path for Pu stored at SRS. The federal court determined that the DOE was authorized to ship Pu to SRS and ruled in DOE's favor. The DOE began shipping Pu to the KAMS in the summer of 2002 and completed the SNM Removal Project in the summer of 2003.

Throughout the SNM Removal Project, the RFETS had to fight for Secure Transportation resources (SSTs) due to the limited resources and higher priorities of National Nuclear Security Administration (NNSA) programs such as weapons production, non-proliferation, and stockpile stewardship. Ultimately, when the Office of Environmental Management could demonstrate that the receiver site was able to receive and that RFETS was ready to ship, then NNSA directed the Secure Transportation Program to provide adequate resources to ensure that the RFETS closure was not delayed. While ultimately successful, this approach required on-going coordination and commitment from the highest levels of DOE management, and was only successful because of that level of support.

Evaluate the actual storage configuration for nuclear materials/SNM during any deviation from routine operations.

KEY SUCCESS FACTORS

1. It is imperative to evaluate the actual storage configuration for nuclear materials/SNM during any deviation from routine operations. The safety basis for nuclear operations assumed a certain set of conditions. If the facility was in an indeterminate status (such as the Rocky Flats shutdown and subsequent delays in resumption of operations) the safety basis may be inadequate to address the actual material conditions. Immediate compensatory measures would be required to mitigate the risks associated with unanalyzed, non-routine operations.

2. With SNM it is extremely important to recognize the need for training and infrastructure. The success of the SNM Shipping Project from 1998 through 2003 is largely attributed to the decision to hire, train, and retain adequate personnel to ensure that these personnel understood and complied with the SNM packaging requirements.

The success of the SNM Shipping Project from 1998 through 2003 is largely attributed to the decision to hire, train, and retain adequate personnel.

3. A NEPA ROD must be issued prior to any major federal action. The Rocky Flats SNM Removal project was delayed several times while waiting for several RODs. The DOE NEPA process was inefficient and was often delayed by political issues. Legal challenges can delay implementation of agency decisions. The DOE should carefully consider the schedule impact of additional NEPA to avoid litigation versus implementing NEPA decisions and fighting any legal battles it they materialize.

NNSA was directed to delay some national security programs to support Rocky Flats closure.

4. It is not enough to assume disposition locations. Receiver sites for SNM must be identified, funded, and directed to provide priority to the shipping site. Several times during Rocky Flats' de-inventory, receiver sites were unable to receive Rocky Flats' SNM due to lack of funding, canceled programs, conflicting priorities, lack of storage capability, or operational concerns.

5. It is not enough to assume the availability of transportation. Secure Transportation resources (SSTs) must be available to transport SNM from shipper to receiver sites. The de-inventory of an EM Site was ranked as a lower priority than NNSA national security projects such as weapons production, stockpile stewardship, and non-proliferation programs. This issue was only resolved at the highest levels of DOE when the NNSA was directed to delay some national security programs in order to support the Rocky Flats closure.

The accelerated closure of the Site made it impractical to take advantage of complex-wide studies, procurements, and certifications.

6. The accelerated closure of the Site made it impractical to take advantage of complex-wide studies, procurements, and certifications. Although the Site always participated in complex-wide, EM-wide, or multi-site/multiple user efforts, these processes rarely had the same priority as the Site Closure. Most sites/programs do not have the urgency and therefore do not have the funding priority to support outyear needs (this is inevitable with dwindling budgets because only the essential near-term needs get funded). The Site could not wait to take advantage of lower priority efforts and therefore paid more for a customized product.

The Site was ready to ship SNM, closure could be accelerated by removing SNM, and dollars and time could be saved by removing all SNM as soon as possible.

7. There were many times when the Site did not have the priority compared to the DOE Weapons Complex and was told that accelerated closure could not be supported. Rather than argue the priority question, the Site simply continued to package and prepare all SNM for offsite shipment. The important thing was demonstrating that 1) the Site was ready to ship SNM, 2) the Site closure could be accelerated by removing SNM, and 3) the bottom line, dollars and time (i.e., dollars) could be saved by removing all SNM as soon as possible. The Site's ability to consolidate SNM into Building 371, shrink the Protected Area around

Building 371, and release entire buildings for accelerated deactivation and D&D mitigated the impact of any priority delays.

8. The Site requested the National Security Exemption (NSE) to allow shipping some Pu composite items in an existing shipping package rather than size reducing the items and certifying another shipping package. Ultimately the NSE approach was abandoned and the Site size-reduced the composites and shipped them in an approved shipping container. The normal certification process should be utilized and any exceptions to that process should be considered risky at best.

The normal certification process should be utilized and any exceptions to that process should be considered risky at best

9. When dispositioning complex items such as HEU weapons parts, the Site should have make sure that disposition planning accounted for the specific characteristics of an item. Unrealistic processing assumptions (i.e., that this system could decontaminate every Pu contaminated HEU item to allow the HEU to be shipped to Y-12) resulted in unnecessary work and SNM disposition delays. If the Site had understood the characteristics of the Pu on these HEU items they may have avoided purchasing a system that met only a limited need.

10. The DOE decision to waste any SNM for which there was no programmatic need was a significant policy change that allowed the Site to stabilize and directly dispose of nearly 3 tons of Pu contained in 106 bulk tons of Pu residues, plus a significant quantity of low-concentration Pu oxides. This decision avoided unnecessary Pu recovery operations (at RFETS, SRS, and LANL) and years of storage and maintenance associated with the Pu that would have been recovered with no programmatic need.

DOE avoided unnecessary Pu recovery operations and years of storage costs for SNM with no programmatic need.

11. The following decisions greatly improved the ability of the Site to accelerate closure while packaging Pu for long-term storage: 1) Installing the PuSPS into Building 371 (instead of Building 707), 2) canceling the originally planned Building 371 3013 system and utilizing just the PuSPS for 3013 packaging, 3) discarding the automated stabilization portion of PuSPS in favor of a manually operated stabilization system.

12. Installing the PuSPS system offsite in an uncontaminated “cold” environment allowed the PuSPS to be tested and improvements identified prior to actual radioactive “hot” operations.

13. The PuSPS automated system was difficult to maintain and unreliable. Automated systems in general require more maintenance and are difficult to repair, especially in a contaminated environment. The pros and cons of automated system benefits versus manual operations simplicity and reliability should be carefully considered. The PuSPS produced detailed

*The PuSPS automated system was difficult to maintain and unreliable. The most significant PuSPS lesson learned was the **Keep It Simple** axiom.*

lessons-learned that were disseminated throughout the DOE Complex.[88]
The most significant lesson learned was the Keep It Simple axiom.

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